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Bansal et al.

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(54) **ASSOCIATING METRO STREET ADDRESS GUIDE (MSAG) VALIDATED ADDRESSES WITH GEOGRAPHIC MAP DATA**

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G06F 17/30 (2006.01)
G01S 5/02 (2010.01)
(52) **U.S. Cl.**
CPC *G06F 17/30241* (2013.01); *G01S 5/02* (2013.01)
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USPC 455/404.1, 404.2, 456.1; 379/45
See application file for complete search history.

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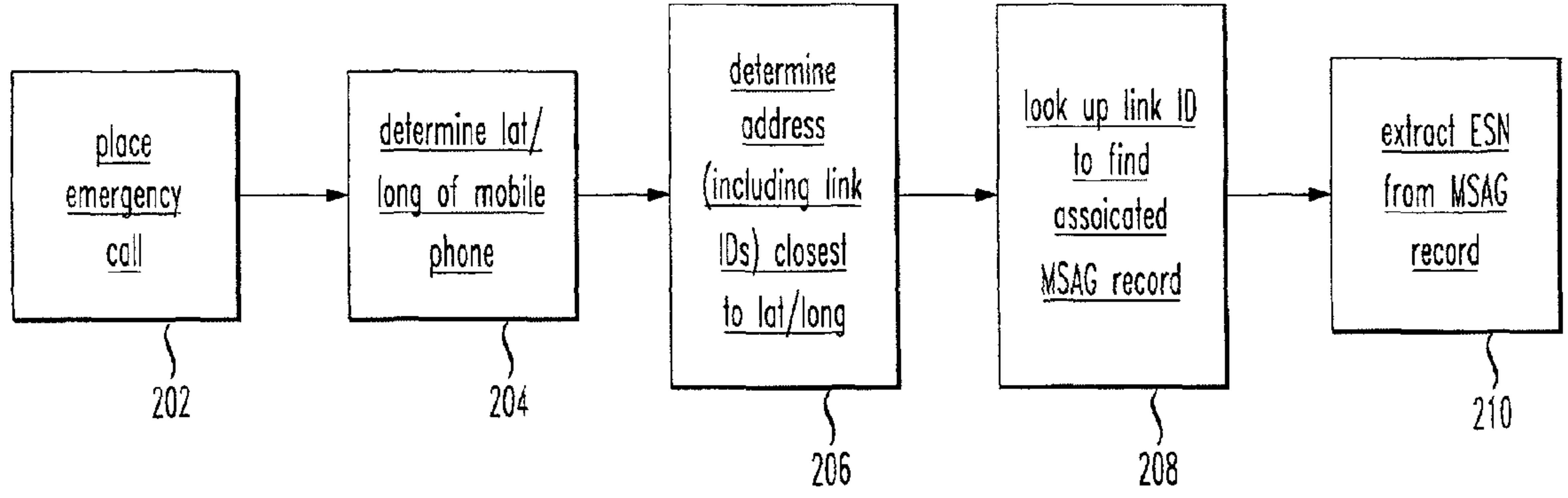
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(57) **ABSTRACT**
Master Street Address Guide (MSAG)-validated street address data is correlated with real-world geographic (e.g., latitude/longitude) data. Conventional MSAG-validated street address data is processed, or geocoded, into an additional (or integrated) database that associates latitude/longitude information with a particular entry in the existing MSAG-validated database. The association of the lat/lon data may be direct, or indirect using link ID or other unique tags indicating a particular entry in the MSAG-validated database. The geocoding need be performed only once by a service provider, e.g., as part of the deployment of an emergency service system. In this way, the closest public service answering point (PSAP) to a given latitude/longitude position of a wireless or VoIP device may be determined quickly, providing emergency services with the smallest possible reliable response time.

6 Claims, 4 Drawing Sheets

CALL HANDLING



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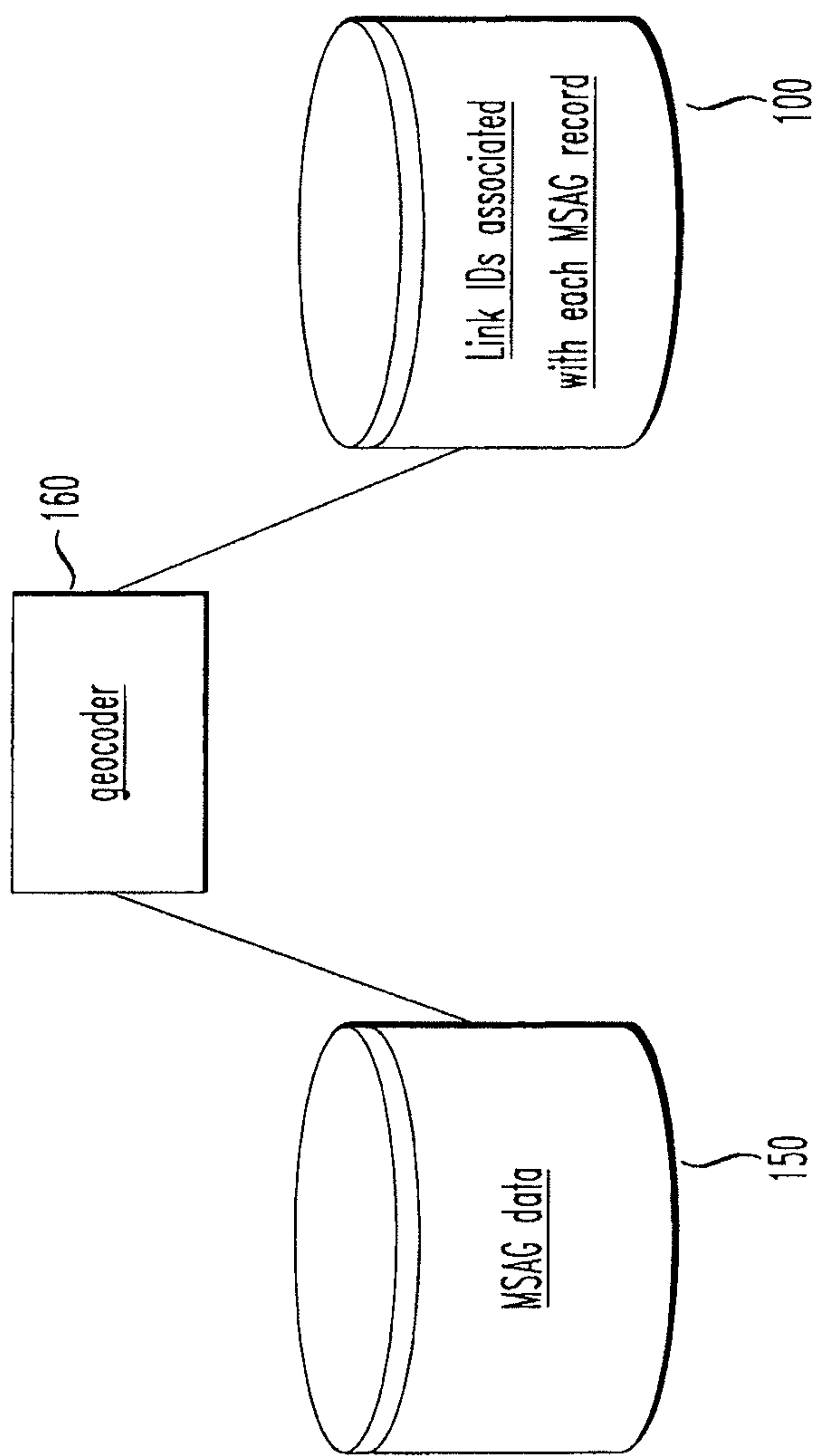


FIG. 1

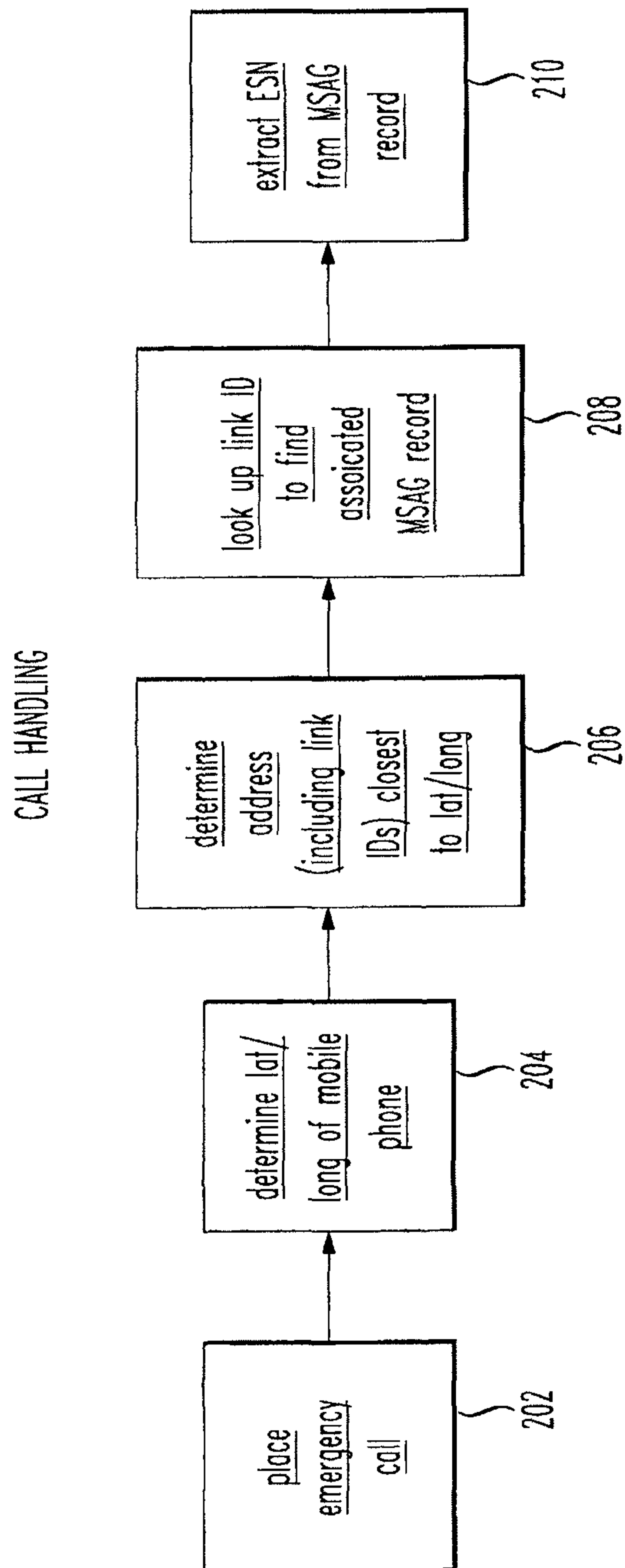


FIG. 2

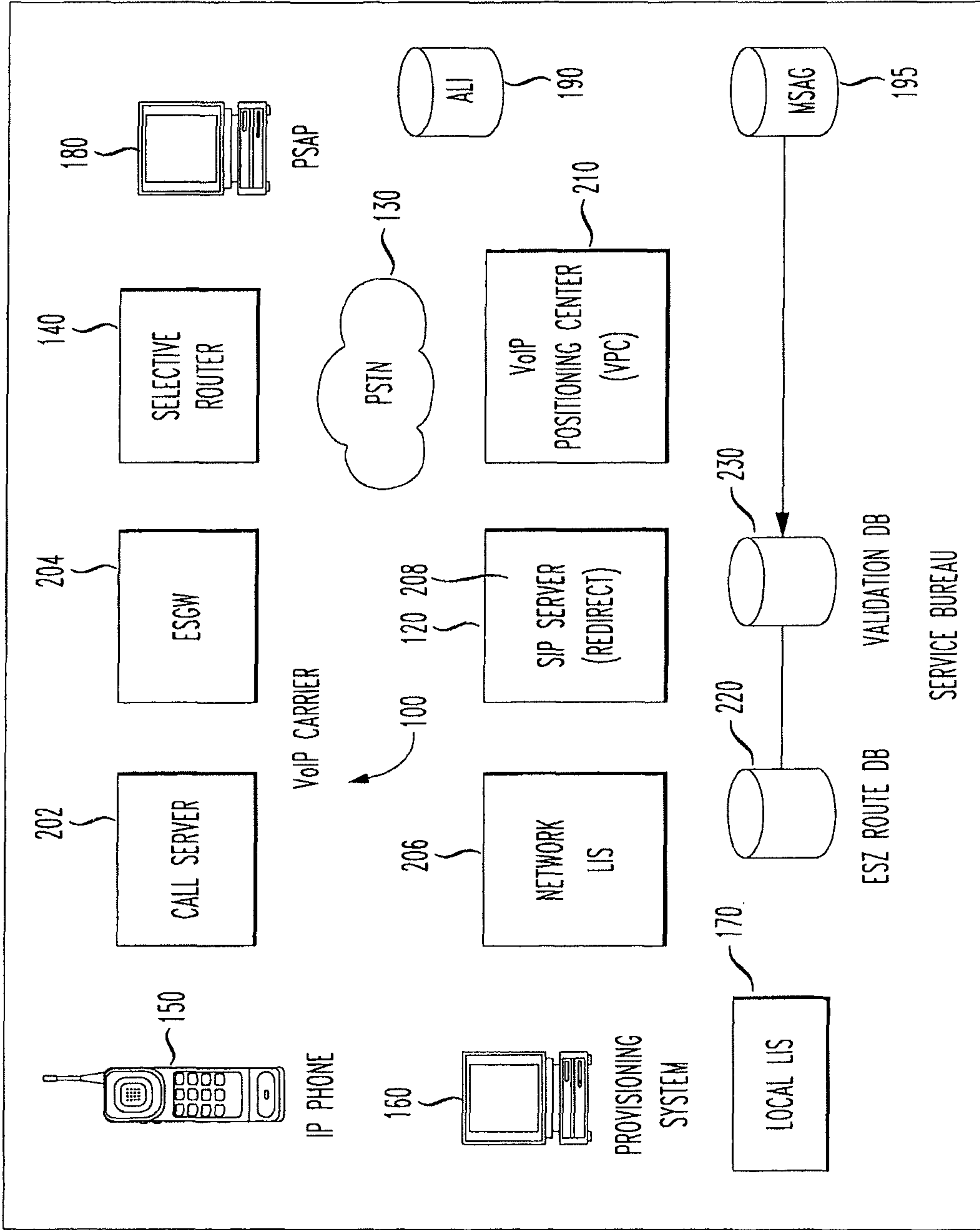


FIG. 3
(PRIOR ART)

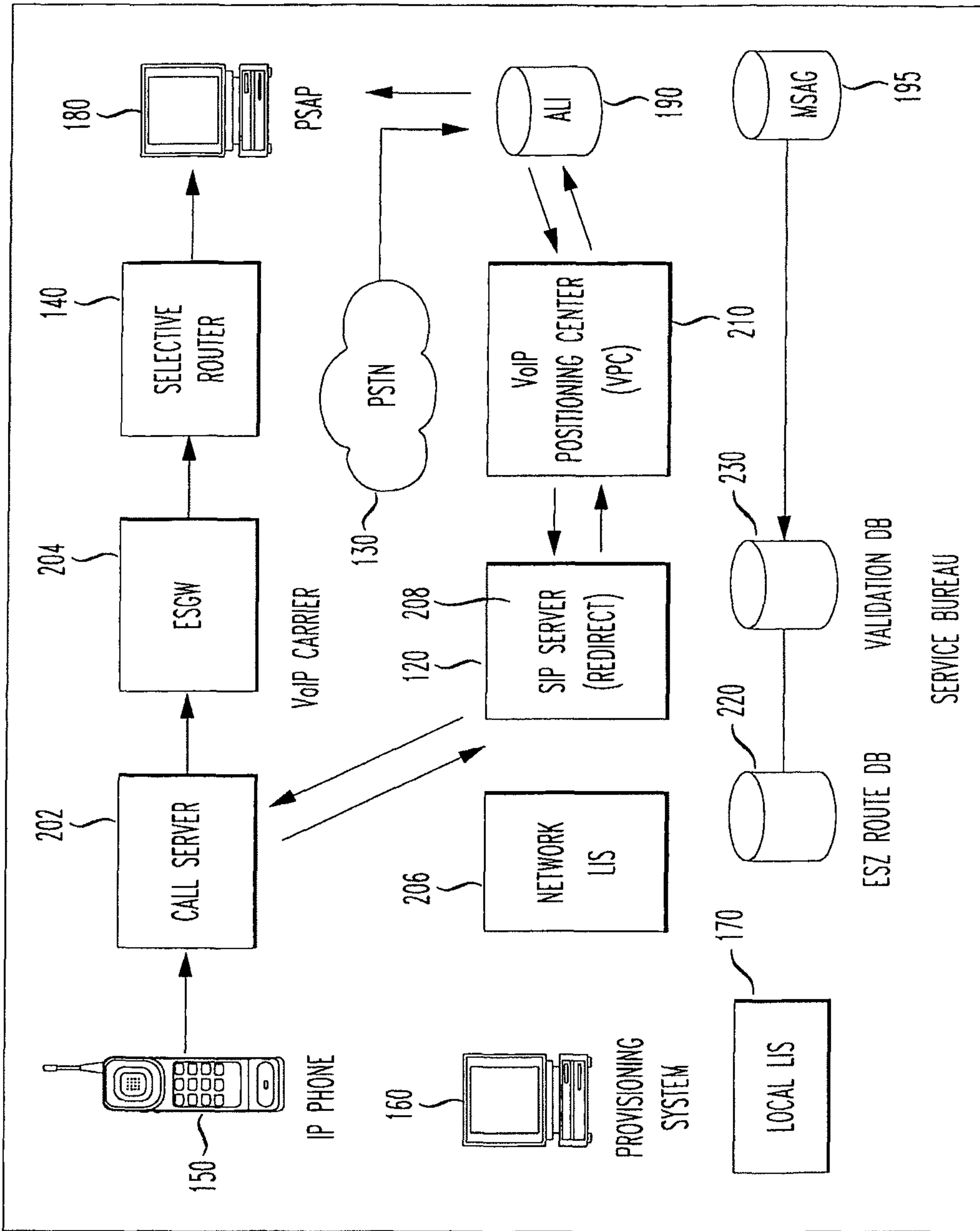


FIG. 4
(PRIOR ART)

**ASSOCIATING METRO STREET ADDRESS
GUIDE (MSAG) VALIDATED ADDRESSES
WITH GEOGRAPHIC MAP DATA**

This application is a continuation of U.S. patent application Ser. No. 11/506,859, entitled "Associating Metro Street Address Guide (MSAG) Validated Addresses with Geographic Map Data", filed on Aug. 21, 2006, now U.S. Pat. No. 8,577,328, the entirety of which is expressly incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to wireless devices as they relate to geographic information systems. More particularly, it relates to the provision of 911 services for wireless users to a Public Safety Answering Point (PSAP).

2. Background of the Related Art

Current public safety infrastructure is heavily wedded to wireline interfaces and to the notion that every E911 caller has a street address-not simply to the notion that latitude/longitude coordinates is more amenable to the mobile phone culture of today. As a result, the E911 industry is challenged with the ability to automatically and reliably deliver location information to the Public Safety Answering Points (PSAPs) for wireless devices. This is also true for most Voice Over Internet Protocol (VoIP) devices, which by the ubiquitous nature of the Internet are not always fixed in location.

For illustration purposes, FIG. 3 shows a conventional E911 VoIP scenario.

In particular, as shown in FIG. 3, a VoIP carrier **100** includes a call server **202** and an Emergency Services Gateway (ESGW) **204**.

A service bureau **120** includes a network location information server (LIS) **206**, a Session Initiated Protocol (SIP) server (redirect) **208**, and a VoIP positioning center (VPC) **210**. Also included in the service bureau **120** is an Emergency Services Zone (ESZ) route database (DB) **220**, and a validation database (DB) **230**.

Also within the network are the Public Switched Telephone Network (PSTN) **130**, a selective router **140**, a Public Safety Answering Point (PSAP) **180**, an Automatic Location Identification (ALI) database **190**, a Master Street Address Guide (MSAG) **195**, an Internet Protocol (IP) phone **150**, a provisioning system **160**, and a local Location Information Server (LIS) **170**.

FIG. 4 shows exemplary call flow for the conventional E911 VoIP scenario shown in FIG. 3.

In particular, as shown in step 1 of FIG. 4, a caller on the IP phone **150** dials 9-1-1; and the call proceeds to the VoIP call server **202**.

In step 2, the VoIP call server **202** sends a Session Initiated Protocol: uniform Resource Identifier (SIP:URI) to the SIP Server (redirect) **208**.

In step 3, the SIP Server **208** queries the VoIP Positioning Center (VPC) **210** for an Emergency Services Routing Number (ESRN) and an Emergency Services Query Key (ESQK). This is conventionally based on a fixed street address that is configured for the particular VoIP user.

In step 4, the VoIP Positioning Center (VPC) **210**, via the SIP Server **208**, returns the ESRN & ESQK to the VoIP Carrier **100**.

In step 5, the call server **202** uses the returned ESRN to route the wireless 911 call to the Emergency Services Gateway (ESGW) **204**.

In step 6, the Emergency Services Gateway (ESGW) **204** routes the wireless 911 call to the selective router **140**.

In step 7, the wireless 911 call is sent to the Public Safety Answering Point (PSAP) with the ESQK.

In step 8, the Public Safety Answering Point (PSAP) queries the Automatic Location Identification (ALI) database **190** using the ESQK.

In step 9, the Automatic Location Identification (ALI) database **190** queries the VoIP Positioning Center (VPC) **210** with the ESQK.

In step 10, the Service Bureau **120** matches the ESQK and returns location information.

Emergency services are most easily provided to a caller using a phone in a fixed location (e.g. a landline). For this situation, a table is created that associates an emergency service number (ESN) to each phone number. However, for a wireless phone the inventors herein realize that this approach no longer works as the location of the phone can change. Given the global positioning satellite (GPS) location (latitude/longitude) of a mobile phone (provided by the relevant cellular service carrier), the task remains to determine the emergency service number (ESN) of the closest PSAP.

Unfortunately, static tables associating phone numbers to ESNs do not work for a wireless or mobile caller, because their location is not determined merely using their phone number and a lookup in the static table. The provision of an acceptable location for a mobile device or even a VoIP device which may or may not be mobile presents a number of challenges, not the least of which is Metro Street Address Guide (MSAG) validation of their location.

Fundamentally, MSAG is a legacy requirement from PSAPs that did (and some still do) have "dumb" terminals that receive the call and display validated street address information to the call taker. In early PSAP systems, information delivery was slow and cumbersome, so the industry worked on developing a set of abbreviations that would allow an address to fit into about 20 characters.

The entire conventional call scenario depicted in FIG. 4 presumes that a database record exists that identifies the location of the customer, and that the database record exists as an MSAG-validated address. In reality, this is not necessarily the case. Nevertheless, current PSAP architectures have entire response procedures built around street addresses only, and use the street address as a key to a table for looking up the appropriate emergency response. Accordingly, the bottom line is that conventional PSAPs require that location information be an MSAG-validated street address to guarantee that the PSAP database lookup will not fail.

Wireless Phase I requirements defined by NENA provide E9-1-1 for VoIP using PSAP administrative lines. Wireless Phase II requirements defined by NENA provide E9-1-1 for VoIP across traditional 9-1-1 channels. In wireless Phase II, the location of the caller is dynamically extracted from the network. This results in a latitude/longitude (lat/lon) coordinate being provided to the PSAP. Those PSAPs which have been upgraded to handle lat/lon receive the information and display it on a screen driven by a Graphical Information System (GIS), i.e., they see a map with a "caller is here" flag or dot. Such a conventional system is suitable in PSAPs which have upgraded to handle these Wireless Phase II calls (currently somewhere north of 40% of all PSAPs). However, older PSAPs still need address information, and they expect to receive an MSAG-validated address. So, for wireless, the address is given as the center of the cell site/sector which is serving the caller. Not very precise, but good enough to get emergency services in a vicinity of a wireless caller.

With Voice Over Internet Protocol (VoIP) usage, it is desirable to apply a similar model as is done in wireless, i.e., to dynamically extract location information from the network, and present it to the PSAP. Unfortunately, VoIP systems, being based on the ubiquitous Internet, can be even more difficult to locate than a wireless device as they do not always have the luxury of a cell site/sector overlay to fall back on. In other words, a VoIP caller can make a 911 call from anywhere in the country, but there is no credible database of MSAG-validated addresses for the Internet routers to deliver the 911 call.

There is a need for a way for wireless and/or VoIP users to have the best of both worlds-provision of location information in latitude/longitude (lat/lon) coordinates to a PSAP, while at the same time providing the PSAP with an MSAG-validated street address location.

SUMMARY OF THE INVENTION

In accordance with the principles of the present invention, a geocoder device and method comprises inputting data from a metro street address guide (MSAG) database. A latitude/longitude location is associated with a plurality of entries in the MSAG database. The associated latitude/longitude location information is stored in a lat/lon association database.

A lat/lon association database for communication over a phone network in accordance with another aspect of the invention comprises a plurality of entries. Each of the plurality of entries associates a street link with its latitude/longitude.

A method and apparatus for determining a validated entry in a metro street address guide (MSAG) associated with a given geographic location, in accordance with yet another aspect of the present invention comprises obtaining a latitude/longitude of an active network device. An addressable street link associated with the obtained latitude/longitude of the active network device is determined. A metro street address guide (MSAG) database is searched for a matching MSAG-validated street address entry to the determined addressable street link.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 depicts the geocoding process of MSAG-validated street address data, and the creation of a lat/lon-to-MSAG record database, in accordance with the principles of the present invention.

FIG. 2 shows an exemplary call handling process using a table associating lat/long data with a closest MSAG record, formed from geocoding, in accordance with the principles of the present invention.

FIG. 3 shows a conventional E911 VoIP scenario.

FIG. 4 shows exemplary call flow for the conventional E911 VoIP scenario shown in FIG. 3.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

The present invention correlates Master Street Address Guide (MSAG)-validated street address data with real-world geographic (e.g., latitude/longitude) data. According to the invention, conventional MSAG-validated street address data is processed, or geocoded, into an additional (or integrated) database that associates latitude/longitude information with a particular entry in the existing MSAG-validated database. The association of the lat/lon data may be direct, or indirect

using link ID or other unique tags indicating a particular entry in the MSAG-validated database.

Ideally the geocoding need be performed only once by a service provider, e.g., as part of the deployment of an emergency service system. Of course, updated geocoding may be performed from time to time as the content of the MSAG-validated street address database changes or is otherwise revised. In this way, the closest public service answering point (PSAP) to a given latitude/longitude position of a wireless or VoIP device may be determined quickly, providing emergency services with the smallest possible reliable response time.

FIG. 1 depicts the geocoding process of MSAG-validated street address data, and the creation of a lat/lon-to-MSAG record database, in accordance with the principles of the present invention.

In particular, as shown in FIG. 1, MSAG-validated street address data, as depicted by the MSAG database **150**, is geocoded by a geocoder **160**, to generate associations between entries in the MSAG database **150** and lat/lon positions. These associations are stored in a separate database **100** associating lat/lon positions to a respective closest entry from the MSAG database **150**.

The geocoder **160** may be any suitable computer, and need not be performed via a network. Preferably the geocoder **160** is operated by a third party software provider rather than by a wireless or VoIP carrier. However, operation of the geocoder **160** by a wireless or VoIP provider is entirely within the present invention.

The lat/lon association database **100** is shown in FIG. 1 separate from the MSAG-validated street address database **150**. Of course, information from the two databases **150**, **100** may be integrated into a common database, in accordance with the principles of the present invention.

The disclosed geocoder **160** geocodes, or divides each road in a given area into lengths, or links, and associates each link with a given ID. The number of links for any given street-addressable road is preferably determined by the number of intersections therewith by other streets, the number of driveways, and/or any other relevant points of distinction. Another factor for dividing a street into links are the places on that street where the street address number changes.

It is entirely possible and feasible that more than one link will be associated with a same entry in the MSAG-validated street address database **150**. For instance, multiple intersections may occur on a street in front of a single street addressed home or business. In this case, the multiple intersections would each associate to a same entry in the MSAG-validated street address database **150** for that single home or business.

A dataset contained in the MSAG-validated street address database **150**, and/or in the lat/lon association database **100**, may describe a small region, state, or even the entire country. In any event, it is important that each link have an identifier that's unique in a given geographic data set. But again, it's entirely possible that multiple identifiers point to a same entry in the MSAG-validated street address database **150**.

Geocoding **160** of the MSAG-validated street address database **150** takes each street address entry in the MSAG-validated street address database **150** as input, and outputs an associated latitude/longitude for each input street address entry.

The exact latitude/longitude designated for any given link is preferably that of a central point of the link. The central point may be determined in any suitable mathematical method for determining a center of an area. As another example, the central point for which the lat/lon data is assigned may be a 2-dimensional calculation measured as a

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midpoint of a linear line drawn along the pathway of the centerline of the street link. If the link is rectangular, the center point may be the cross-point of two straight lines drawn from opposing corners of the rectangle. The central point may also be calculated in 3-dimensions using not only the geographic shape of the length and width of the link, but also variation in altitude.

The lat/lon assigned to any given link may be a range of lat/lon values, though such implementation adds significantly to complexity of the lat/lon association database **100**.

In addition to the exact latitude/longitude, the geocoding also determines a unique link ID for each link in the lat/lon association database **100**. The format of the link ID may be any suitable format for a database. In the preferred embodiment, the link ID is uniquely assigned for each entry in the lat/lon association database **100**.

Each MSAG record in the MSAG-validated street address database **150** associates an address range with an emergency services number (ESN), and therefore a particular public safety answering point (PSAP) responsible for that geographic location. The present invention associates MSAG record entries with IDs for all links in the address range, thus solving the conventional problem of reliably locating the closest PSAP to a given lat/lon position as a simple lookup of the link ID for a given lat/lon position.

FIG. 2 shows an exemplary call handling process using a table associating lat/long data with a closest MSAG record, formed from geocoding, in accordance with the principles of the present invention.

In particular, as shown in step **202** of FIG. 2, an emergency 911 call is placed from a wireless or VoIP device.

In step **204**, the lat/lon of the 911 caller is determined. This determination may be performed in any conventional manner, including cell site location, global positioning satellite (GPS), etc.

In step **206**, the closest street link ID entry in the lat/lon association database **100** is determined, based on the latitude/longitude data determined in step **204**.

In step **208**, using the closest link ID determined in step **206**, a look up is performed in the MSAG-validated database **150**, to find the associated MSAG-validated record in the MSAG-validated database **150**.

In step **210**, the emergency services number (ESN) of the PSAP assigned to the location of the wireless or VoIP 911 caller is extracted from the associated MSAG-validated record matched in step **208**.

Thus, each MSAG address range in an otherwise conventional MSAG-validated street address database **150** is geocoded to find associated link IDs and corresponding latitude/longitude data for each link ID, and that association is stored in a data table. Then, when an emergency call arrives, the link ID is determined based on a lat/lon of a calling wireless or VoIP party via look up in a lat/lon association table. If it is present in the lat/lon association database **100**, the link ID of that match in the lat/lon association table is used in a look up in the MSAG-validated street address database **150** to find the relevant MSAG-validated record nearest to the current position of the wireless or VoIP 911 caller. The emergency services number (ESN) is extracted from the matched MSAG-validated record.

If the emergency caller's link ID isn't found in the lat/lon association table, it would indicate that the data contained in the MSAG-validated street address database **150** is incomplete. To this end, the geocoding process of each MSAG record in the MSAG-validated street address database **150** helps to validate the MSAG data. If a particular MSAG record fails to geocode, it indicates that something is inconsistent

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between the MSAG and the real-world geographic data. It is also possible for MSAG records to overlap. Thus, the present invention not only provides reliable MSAG-validated street address information to emergency services for wireless and/or VoIP 911 callers, it actually improves the quality and reliability of the MSAG-validated database **150** itself, by way of resolution of any inconsistencies in the geocoding process.

Since geocoding in accordance with the present invention occurs early in the process, it is possible to resolve these inconsistencies ahead of time, before any negative impact to emergency calls can occur, again not only equaling the reliability of wireline emergency calls with wireless and/or VoIP callers, but actually improving upon it.

The present invention has particular applicability to providers of E911 emergency services for wireless devices, especially mobile phones.

While the invention has been described with reference to the exemplary embodiments thereof, those skilled in the art will be able to make various modifications to the described embodiments of the invention without departing from the true spirit and scope of the invention.

What is claimed is:

1. A method of mapping a current lat/lon location of a wireless device into a street address, comprising:

obtaining a current latitude/longitude location of a wireless device;

determining a unique road link ID associated with said obtained current lat/lon location; and

returning a street address associated with said unique road link ID;

wherein a given length of road is divided into a plurality of road links each associated with its own unique road link ID; and

wherein said unique road link ID is associated with a two-dimensional area of road including a range of latitude coordinates and a range of longitudinal coordinates, said current lat/lon location falling within said range of latitude coordinates and within said range of longitudinal coordinates.

2. A method of mapping a current lat/lon location of a wireless device into a street address, comprising:

obtaining a current latitude/longitude location of a wireless device;

determining a unique road link ID associated with said obtained current lat/lon location; and

returning a street address associated with said unique road link ID;

wherein a given length of road is divided into a plurality of road links each associated with its own unique road link ID; and

wherein said given length of road is divided at crossroads.

3. A method of mapping a current lat/lon location of a wireless device into a street address, comprising:

obtaining a current latitude/longitude location of a wireless device;

determining a unique road link ID associated with said obtained current lat/lon location; and

returning a street address associated with said unique road link ID;

wherein a given length of road is divided into a plurality of road links each associated with its own unique road link ID; and

wherein said given length of road is divided at driveways.

4. A method of mapping a current lat/lon location of a wireless device into a street address, comprising:

obtaining a current latitude/longitude location of a wireless device;

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determining a unique road link ID associated with said
obtained current lat/lon location; and
returning a street address associated with said unique road
link ID;
wherein a given length of road is divided into a plurality of 5
road links each associated with its own unique road link
ID; and
wherein said given length of road is divided at locations
where street address numbers change.
5. A method of mapping a current lat/lon location of a 10
wireless device into a street address, comprising:
obtaining a current latitude/longitude location of a wireless
device;
determining a unique road link ID associated with said 15
obtained current lat/lon location; and
returning a street address associated with said unique road
link ID; and

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associating an emergency services number with said
unique road link ID;
wherein a given length of road is divided into a plurality of
road links each associated with its own unique road link
ID.
6. A method of mapping a current lat/lon location of a
wireless device into a street address, comprising:
obtaining a current latitude/longitude (lat/lon) location of a
wireless device;
determining a closest unique road link ID associated with
said obtained current lat/lon location; and
returning a street address associated with said unique road
link ID;
wherein a given length of road is divided into a plurality of
road links each associated with its own unique road link
ID.

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